Insect Crop Losses and Insecticide Usage for Spring Melons in Southwestern Arizona: 2004 - 2006

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Abstract

Impact assessment is central to the evolution and evaluation of our IPM programs. Quantifiable metrics on insecticide use patterns, costs, targets, and frequency, crop losses due to all stressors of yield and quality, and other real world economic data (e.g., crop value) are our most objective tools for assessing change in our systems. We recently initiated a project to measure the impact of insect losses and insecticide uses in cantaloupes and watermelons grown in Yuma, AZ and the Bard–Winterhaven area of Imperial County, CA. The data generated in this report is useful for responding to pesticide information requests generated by EPA, and can provide a basis for regulatory processes such as Section 18 or 24c requests, as well as for evaluating the impact of our extension programs on risk reduction to growers. This information also confirms the value of PCAs to the melon industry by showing the importance of cost-effective management of insect pests in desert production.

Introduction

The development of accurate "real world" data on crop insect losses and insecticide usage is important to the assessment of our IPM programs in Arizona. Quantifiable measurements of insecticide use patterns, costs, target pests, and yield/quality losses due to key insect pests are our most objective tools for assessing change in our systems. These data allow us to build relevant databases for measuring user behaviors and adoption of new IPM technologies. This is information important for several reasons. First, specific data on pesticide use patterns and insect losses can be useful for providing information to EPA and other regulatory agencies in submitting Section 18 and 24c requests, as well as support the tolerance of older active ingredients that are critical to the melon industry. In addition, it can directly demonstrate the value of new pest control technologies and IPM tactics. From an academic perspective, these databases help to re-direct the efforts of the College of Agriculture by providing key stakeholder input to our applied research and extension programs. This "real world" input from the industry documents the relevancy of key pest problems and has become mandatory for competing for federal grant funding. Finally, for pest control advisors (PCAs), it can translate their efforts into economic terms for their clientele and confirms their value to the melon industry by showing the importance of key insect pests and their cost-effective management in desert production. This report documents the development of "real world" data on actual insect loss data for cantaloupes and watermelons, and estimates of the level of insecticidal control needed to prevent key insect pests from reducing yield and quality.

Data Collection

The data was developed through the administration of a three-part survey that was conducted in an interactive process with stakeholder input. Growers, PCAs, Extension personnel and industry professionals attended spring Melon Insect Losses and Impact Assessment Workshops in Yuma in June of 2005 and 2006 and completed surveys in a guided process. The workshops were conducted in an interactive manner where participants were given a presentation that established the incentives for participation, explained the crop insect loss system, and further walked the participants through the estimation process. The three part survey instrument collected the following information:

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Part I: Information was collected on the actual cantaloupe and watermelon acreage represented by the respondent, estimates of actual yields and potential yields for this acreage (Table 1), and overall percent reductions in yields due to several biological, environmental and management factors (Table 2). In addition, costs associated with aerial and ground applications (Table 3) and insect management fees for scouting (Table 4) were estimated.

Part II. Information was collected on crop insect losses through the description of the percentage of acres where key insect pests were present and insecticide sprays were required to prevent yield reductions in cantaloupes and watermelons. Included with those estimates are the frequency and costs of insecticide applications directed towards those insects. Overall, these costs represent a loss to the grower associated with preventing insects from damaging plants and reducing yields. Finally, actual percent yield losses (heads not harvested due to insect damage or injury) for individual insect species or complexes were estimated (Table 5 and 6).

Part III: Data on insecticide use patterns was collected. These data identify the frequency of use of various chemistries (identified by both product name and IRAC mode-of-action classification) and the percentage of treated cantaloupe and watermelon acres for each product (Table 9).

Results and Discussion

Part I: The Spring Melon Insect Losses Workshops in Yuma were attended by 18 growers, PCAs, Extension personnel and other stakeholders in 2005, and 12 in 2006. A total of 6 completed surveys collected at the Yuma meeting in 2006 represented 56% of acreage for spring cantaloupes and 60% of the acreage for watermelons (down from 8 completed surveys in 2005; 90% and 76% representation of cantaloupe and watermelon acreage, respectively) (Table 1). The large majority of acres reported were for melons grown in Yuma county (~80%), with the remainder representing the adjacent Bard/Winterhaven area of Imperial County, CA. Because of their proximity and similarities to each other, data were combined for these two growing areas in each year. Estimates of yields (both actual and potential) varied between years and melon types, where estimates for yield losses range from 20-30% for both crops. These values are also fairly consistent with the PCA and grower estimates of specific factors responsible for yield losses.

Estimates for specific factors responsible for seasonal yield reduction varied as well (Table 2). Overall, weather and disease constituted the factors that PCAs and growers felt were most responsible for yield reduction. This makes sense since spring melons are planted under cool temperatures and higher amounts of rainfall. This was certainly the case in the spring of 2005 when we had unusually high amounts of rainfall (almost 3X more than the average). Disease pressure can also be heavy during the spring (i.e. powdery mildew). However, disease losses were reportedly much lower in 2006 for watermelons compared to the previous year. Losses for all insects ranged from 1.5-3.8 % and varied between years and melon crops. This is consistent with the unpredictable nature of insect outbreaks that are often influenced by weather and adjacently grown spring produce crops. Surprisingly, yield reductions due to birds was >0.5 %. PCAs have reported that crop losses due to bird damage have been getting worse each year. Percent reduction in yield by other factors included: poor crop management practices, weak melon markets / harvest losses and loss in marketable melons /acre due to the use of non-marketable pollinators used for seedless watermelon production. Collectively, these factors were reported to be responsible from 0 – 3.3% of the annual crop losses in spring melons

Estimates for aerial and ground insecticide applications on spring melons varied between years and crops (Table 3). In general, more than 50% of all acres were treated by both air and ground on an average of about 3 times per acre. Average costs for insecticides applied by ground were about 30% higher than applied by air. However, costs for ground applications decreased slightly between 2005 and 2006, but increased for aerial spraying. Not surprisingly, respondents estimated that 100% of their acres where scouted, monitored and sampled for insect activity (Table 4). The number of field visits per week was fairly consistent between years and crops, averaging more than 3 field visits per week. Estimates for the cost of scouting were higher for cantaloupes and increased almost 15% in 2006 to an average of $19.75 / acre. Similarly, costs increased > 10 % in 2006 for scouting watermelons. It was not documented why these costs increased in one year, but as discussed openly after the 2006 workshop, may be a reflection of the increased cost of melon production, and in particular chemicals and fuel. Irregardless, these insect management costs suggest that Arizona melon growers find significant value in the expertise and service provided by their PCAs.

Part II: Insect Crop Losses

Spring Cantaloupes: Insects important at stand establishment such as seedling pests (ground beetles, earwigs, and crickets) and seed corn maggots were treated on greater than 40 % of the acreage in 2005, and > 20% in 2006 (Table 5). The average cost to control these pests was around $ 12.00 / acre. Seedling pests accounted for less than 0.1% yield loss, but seed corn maggot was responsible for almost 1% losses in 2005. Flea beetles and leafminers were only minor pests in 2005, and were not treated for in 2006. No yield loss was reported for flea beetles in either year, with only marginal losses reported for leafminer in 2005.

The lepidopterous larval complex consisting of beet armyworm and cabbage looper accounted for significant control costs in spring cantaloupes. Beet armyworm was treated more frequently in 2005 (2 sprays/ acre), but was treated on a higher percentage of acres in 2006 (18.4%). Yield losses were negligible (<0.1%) in both years. In contrast, cabbage looper was a much more significant pest and was responsible for more yield losses in 2005 than any other pest. The larvae can cause significant quality losses to cantaloupes by feeding on the netting of maturing fruit rendering them unmarketable. Yield losses attributed to this damage was estimated at 1.1 and 0.6 % in 2005 and 2006, respectively. PCAs reported that an average of ~ 1 application /acre was made in both years at costs ranging from about $25-30 /acre.

Whiteflies (sweetpotato whitefly, *Bemisia tabaci* – B biotype) were reported to be present on nearly 100% of the spring acreage in both years, and required additional foliar sprays on 64.7% and 100 % of the spring acres in 2005 and 2006 respectively. This is consistent with our observations on seasonal populations in the Yuma Valley where adult populations were very light in 2005. This may also be reflected in the estimates of yield losses to whitefly which were 4 times higher (1.3%) in 2006. Control costs with foliar sprays ranged from $30-35 / acre. Admire and other soil applied neonicotinoids were applied to 93.4 and 100% of the spring acreage in 2005 and 2006, respectively (Tables 7). Average costs/acre for these products was ~15% lower in 2006 and could be a result of lower rates used or reduced prices. Whiteflies were the most significant pest in 2006, causing more yield loss than any other insect pest. Aphids are considered occasional pests of cantaloupes primarily due to transmission of virus and colonization is rare. Since the wide-spread use of Admire, incidence of aphid-transmitted virus has been almost none existent. However, growers reported spraying for aphids in spring cantaloupes on >15% of the acreage in 2005.

Thrips and spider mites are rarely found to damage spring cantaloupes and this is evident over the past two years by reported lack of control and yield loss. Similarly trash bugs, particularly false chinch bug can cause problems on melons, but were caused only marginal problems for PCAs in 2005. Although darkling beetles can cause problems on spring cantaloupes at harvest by feeding on mature fruit, no control or yield losses were reported in either year.

Watermelons: Insects important at stand establishment are generally thought to be less important on watermelons because the bulk of the production is of transplanted seedless varieties. The estimates for control costs and yield losses from both 2005 and 2006 for these pests suggest this as well (Table 6). However, flea beetle and leafminer appeared to be more important pests in watermelons than what PCAs reported for cantaloupes. In 2005, 73% of the spring acres were treated a single time for both insects at average cost of $ 25 / acre. Flea beetles were not reported as a problem in 2006, and leafminers were treated on about 50% fewer acres in 2006.

Lepidopterous larve are annual pests of watermelons because of aesthetic damage resulting from feeding on immature fruit. Beet armyworm is generally thought to be more important, but PCAs reported that cabbage looper actually caused more damage to watermelons in both years, albeit marginal in 2005. Both species required ~ 2 applications at a cost of ~ $30.00 / acre. In 2006, yield losses to cabbage looper and beet armyworm were higher than any other insect pests. Similarly, whiteflies were the most damaging pest in 2005, causing estimated yield losses of 1.3% and receiving foliar sprays on 100% of the reported acres. Fewer acres where treated in 2006, but application frequency was greater. Interestingly, less than 40% of the acreage was treated with Admire in each year. This might in part explain the higher number of foliar applications in watermelons when compared with cantaloupes.

Aphids and spider mites are frequent pests in watermelons grown in southwestern Arizona. Although no yield losses were reported for these two pests, a significant number of acres were treated in 2005. Aphid pressure appeared to be much lighter in 2006, but spider mites were especially troublesome, requiring treatment on greater than 70% of the acreage. Trash bugs were treated on a similar number of acres in 2005, but did not appear to be present in 2006.

Part III: Insecticide Usage

The frequency of use and the percentage of treated acres for insecticides applied on spring melons are shown in Table 9. The individual insecticide products are grouped by the IRAC mode-of-action classification (http://www.irac-online.org). This system groups chemistries with a similar mode-of-action with a common number so that users can effectively rotate different chemistries in resistance management programs. We list insecticides by a product name when possible; otherwise the chemical name is listed. Pyrethroids were listed by class because of the numerous products registered in head lettuce.

The carbamate and organophoshphate chemistries are listed within IRAC Group 1 because of their common mode-of-action. Among this group, Vydate (oxymyl) and Diazinon was the most commonly used products in both acreage treated and number of applications per acre. Vydate was only used on watermelons in 2006, but was applied an average of 2 time on >35% of the acres reported. Similarly, Diazinon was used on about the same number of watermelon acres in 2006, and only a few acres of cantaloupes were treated. Dimethoate was also used on a few acres of cantaloupes in 2006. Endosulfan (Group 2A) was used on 12.7% of cantaloupes acres in 2005, but a six-fold increase in use (86%) was reported in 2006, presumably for whitefly and cabbage looper control. Similarly, endosulfan in watermelon was applied on greater than 60% of the reported acreage in 2006.

Pyrethroids (Group 3) in cantaloupes were used on almost 50% of the acreage in 2005, increasing to 73.7 % of the treated acres in 2006. In watermelons, foliar applications of pyrethroids were consistently the most heavily used insecticide in both years, both in frequency of use and % treated acres. They provide broad spectrum activity against pests such as darkling beetle, flea beetle, and moths that are not controlled with many of the new, selective insecticides. Also, it is commonly applied through sprinkler chemigation for control of pests at stand establishment. Pyrethroids such as bifenthrin or Danitol combined with endosulfan are one of the most efficacious adulticides available for whiteflies.

Group 4A represents the neonicotinoid chemistry which includes Admire, generic imidacloprid (Alias), Platinum and the newly registered Venom. This class of chemistry represents the most efficacious group of insect ides available for management of whiteflies and aphids in melons. Admire was by far the most heavily used neonicotinoid on both watermelons and cantaloupes. In 2005, Admire was used on 93.4% of the acreage, but dropped to 81.6% in 2006, likely due to the increase use of generic imidacloprid. However, total soil applied neonicotinoid use in 2006 exceeded 100% of the treated acres. Use of Admire was comparatively lower watermelons where it was used on less than 35% of the reported acreage. With the exception of a small usage of Venom in 2006, no other neonicotinoid use was reported on watermelons.

The second most heavily used compound in watermelons was Success (Group 5). The percentage of treated acres decreased slightly between years, but spray frequency increased. In cantaloupes, use was considerably lower, particularly in 2006 where it was treated on only 21% of the reported acres. Success use in watermelons is primarily targeted against lepidopterous larvae which are one of the primary pests responsible for yield losses in Arizona melons. Another product used for lepidopterous larvae control in melons included Intrepid (18A), which was applied to almost 50% of the cantaloupes acres in 2006. Agrimek (6) is an effective insecticide compound for leafminer and mite control, but was reportedly treated on only watermelons in 2006. This is consistent with the number of acres that were treated for these pests in 2006 (Table 6). The other products that had significant use reported were Courier and Oberon, two selective insecticide with good whitefly activity. They were used on a higher percentage of watermelons acres, where Courier use declined significantly in 2006, and Oberon use increased from 0% treated acres in 2005 to nearly 75% treated acres in 2006.

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Table 1. Number of respondents and reported acreage and yields for spring melons in the 2005 and 2006 spring growing seasons.

	Cantaloupes			Watermelons	
Survey use stats	***2005***	***2006***		***2005***	***2006***
No. of PCA respondents	*8*	*6*		*8*	*6*
Acreage reported for these estimates	3805	2280		1370	950
Estimated yield /acre (cartons) (tons)	725	800		32.5	33
Potential yield / acre (cartons) (tons)	1050	1025		47.5	40.7

Table 2. Percent reductions in yields due to several biological, environmental and management factors for spring melons in the 2005 and 2006 growing seasons.

	Yield Reduction (%)				
	Cantaloupes			**Watermelons**	
Factor	***2005***	***2006***		***2005***	***2006***
Weather	9.9	3.8		7.5	8.3
Chemical injury	2.3	0		3.8	0.3
Weeds	1.1	1.6		0.3	0.7
Disease	9.3	10.8		9.0	2.7
All insects	3.8	1.5		2.8	2.0
Birds	0.3	0.3		0	0.3
Other factors	0.3	1.3		0	3.3
Avg. Total Losses	26.8	19.3		23.4	17.6
	23.1			20.5	

Table 3. Frequency and costs for aerial and ground applications on spring melons in the 2005 and 2006 growing seasons

	Cantaloupes			Watermelons	
Insecticide Applications	***2005***	***2006***		***2005***	***2006***
Aerial application					
% acres treated	69.0	97.5		58.0	33.3
No. applications	1.5	2		0.8	2
Cost ($) / application	9.00	11.00		8.75	10.00
Ground application					
% acres treated	75	77.5		100	89.3
No. applications	1.7	1.4		2.3	2.7
Cost ($) / application	14.60	14.00		13.60	12.00

Table 4. Insect management costs for spring melons in the 2005 and 2006 growing seasons

	Cantaloupes			Watermelons	
Insect Management	***2005***	***2006***		***2005***	***2006***
% acres scouted	100	100		100	100
No. field visits/wk	3.3	3.3		3.3	3.7
Cost ($) / acre	16.90	19.75		15.75	17.60

Table 5. Insect losses and control costs on spring cantaloupes in the 2005 and 2006 growing seasons

	Cantaloupes							
	2005				2006			
Pest	**Treated Acres** *(%)*	**Foliar Insecticide Applications** *(No./ac)*	**Control costs** *($/ac)*	**Yield loss** *(%)*	**Treated Acres** *(%)*	**Foliar Insecticide Applications** *(No./ac)*	**Control costs** *($/ac)*	**Yield loss** *(%)*
Seedling Pests	42.6%	1	$14.00	< 0.1%	21.1%	1	$12.00	< 0.1%
Seedcorn Maggot	41.2%	1.5	$12.00	0.8%	29.0%	1	$12.50	0
Flea beetles	7.8%	1	$18.50	0%	0%	1	$25.00	0
Leafminers	7.1%	1	$32.50	< 0.1%	0%	0	$0	0
Beet armyworm	8.1%	2	$27.50	< 0.1%	18.4%	0.8	$21.50	< 0.1%
Cabbage looper	80.2%	1.1	$29.90	1.1%	97.4%	0.9	$25.70	0.6%
Whiteflies	64.7%	1.3	$30.40	0.3%	100%	1.8	$35.30	1.3%
Aphids	16.1%	1	$24.00	0%	0%	0	$0	0
Thrips	0%	0	$0.00	0%	0%	0	$0	0
Spider Mites	0.6%	1	$20.00	0%	0%	0	$0	0
Trash bugs	5.8%	1	$20.00	0%	0%	0	$0	0
Darkling Beetles	0%	0	$0.00	0%	0%	0	$0	0

Table 6. Insect losses and control costs on spring watermelons in the 2005 and 2006 growing seasons

	Watermelons							
	2005				2006			
Pest	**Treated Acres** *(%)*	**Foliar Insecticide Applications** *(No./ac)*	**Control costs** *($/ac)*	**Yield loss** *(%)*	**Treated Acres** *(%)*	**Foliar Insecticide Applications** *(No./ac)*	**Control costs** *($/ac)*	**Yield loss** *(%)*
Seedling Pests	0	0	0	0	0	0	0	0
Seedcorn Maggot	0	0	0	0	0	0	0	0
Flea beetles	73.0%	1	$25.00	0	0	0	0	0
Leafminers	73.0%	1	$25.00	0	36.8%	1	$50.00	0
Beet armyworm	73.0%	2	$30.00	0	100%	2.2	$29.00	0.7%
Cabbage looper	100%	1.7	$31.50	< 0.1%	100%	2.2	$29.00	1.1%
Whiteflies	100%	2	$50.00	1.3%	64.7%	2.3	$30.30	0.3%
Aphids	43.8%	1	$30.00	0	3.2%	1	$20.00	0
Thrips	0	0	0	0	0	0	0	0
Spider Mites	32.1%	1.3	$26.30	0	71.6%	1	$35.70	0
Trash bugs	73.0%	1	$20.00	0	0	0	0	0
Darkling Beetles	0	0	0	0	0	0	0	0

Table 7. Frequency and costs of chemigation and soil-applied insecticides at stand establishment on spring cantaloupes in the 2005 and 2006 growing seasons.

	Cantaloupes			
	% Treated acres		Cost $ of one application/acre	
Treatment	**2005**	**2006**	**2005**	**2006**
Chemigation treatments used at stand establishment	44.9	3.5	12.30	12.00
Soil applied insecticide used (Admire, generic imidacloprid, Platinum, or Venom)	93.4	100	62.50	52.30

Table 8. Frequency and costs of chemigation and soil-applied insecticides at stand establishment on spring watermelons in the 2005 and 2006 growing seasons.

	Watermelons			
	% Treated acres		Cost $ of one application/acre	
Treatment	**2005**	**2006**	**2005**	**2006**
Chemigation treatments used at stand establishment	0	36.8	0.00	10.00
Soil applied insecticide used (Admire, generic imidacloprid, Platinum, or Venom)	31.4	37.9	66.50	72.00

Table 9. Insecticide usage on spring cantaloupes and watermelons in the 2005 and 2006 growing seasons

IRAC MOA Group	Product	Cantaloupes				Watermelons			
		2005		2006		2005		2006	
		Treated acres (%)	No. times applied (No./ac)	Treated acres (%)	No. times applied (No./ac)	Treated acres (%)	No. times applied (No./ac)	Treated acres (%)	No. times applied (No./ac)
1A	Lannate	0	0	0	0	0	0	0	0
1A	Vydate	0	0	0	0	0	0	36.8	2
1B	Diazinon	5.5	1	0	0	0	0	34.6	1
1B	Dimethoate	0	0	3.5	1	0	0	0	0
1B	Metasystox -R	0	0	0	0	0	0	0	0
2A	Endosulfan	12.7	1.4	86.0	1	26.3	1.3	62.3	1.5
3	Pyrethroids	48.4	1.5	73.7	2	99.3	1.8	100	1.8
4A	Admire	93.4	1	81.6	1	31.4	1	34.7	1
4A	Generic imidacloprid	0	0	18.4	1	0	0	0	0
4A	Platinum	0	0	0.8	1	0	0	0	0
4A	Venom	0	0	0	0	0	0	6.3	1
5	Success	67.7	1.5	21.1	1	90.6	1.3	87.1	1.7
6	Agrimek	0	0	0	0	0	0	18.4	1.3
9B	Fulfill	0	0	0	0	0	0	0	0
11B	Bt (ie. Dipel/Javelin)	3.2	1	0	0	2.2	1	0	0
16	Courier	5.4	1	37.3	1	68.6	1	18.9	1
18A	Intrepid	19.7	1	47.4	1	21.9	1	31.6	1
23	Oberon	0	0	49.1	1	0	0	74.7	1